Claims

1. A method of forming a disulfide bond, the method comprising reacting an organic compound comprising at least one thiol group with a compound of formula I:

$$R-S-X-R^1 \qquad I$$

wherein:

X denotes SO_2 or Se;

R denotes an organic moiety; and

R^1 denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group;

with the proviso that when X denotes SO_2 then R^1 does not denote optionally substituted alkyl.

2. A method according to claim 1, wherein the organic compound comprising at least one thiol group is an amino acid, a peptide or a protein.

3. A method of chemically modifying a protein, peptide or amino acid comprising at least one thiol group, the method comprising reacting said protein, peptide or amino acid with a compound of formula I:

$$R-S-X-R^1 \qquad I$$

wherein:

X denotes SO_2 or Se;

R denotes an organic moiety; and

R^1 denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group;

with the proviso that when X denotes SO_2 then R^1 does not denote optionally substituted alkyl.

4. A method according to any one of claims 1 to 3, wherein R is a carbohydrate group.

5. A method according to any one of claims 1 to 4, wherein R^1 is phenyl.

6. A method according to any one of claims 1 to 5, wherein X is Se.

7. A method according to any one of claims 1 to 5, wherein X is SO_2.

8. A compound of formula I:

$$R—S—X—R^1 \qquad I$$

wherein:

X denotes SO_2 or Se;

R denotes a carbohydrate moiety; and

R^1 denotes an optionally substituted alkyl group, an optionally substituted phenyl group, optionally substituted pyridyl group or an optionally substituted naphthyl group;

with the proviso that when X denotes SO_2, then R^1 does not denote optionally substituted alkyl.

9. A compound according to claim 8 wherein R^1 is phenyl.

10. A compound according to claim 8 or claim 9, wherein X is Se.

11. A compound according to claim 8 or claim 9, wherein X is SO_2.

12. A method for preparing a compound of formula I as defined in claim 11, said method comprising reacting a compound of formula II:

$M(SSO_2R^1)_k$ II

wherein:

M denotes a metal, for example Li, Na, K, Ca, Cs, Zn, Mg, or Al; and

k denotes 1, 2 or 3;

with a compound of formula III:

R—L III

wherein:

L denotes a leaving group.

13. A method for preparing a compound of formula I as defined in claim 11, said method comprising reacting a disulfide compound of formula VIII:

R—S—S—R

VIII

with a sulfinite anion of formula $R^1SO_2^-$ in the presence of silver ions.

14. A method for preparing a compound of formula I as defined in claim 10, said method comprising reacting a compound of formula V:

R—SH V

with a compound of formula VIa or VIb:

R^1SeL^2 VIa $R^1Se(OH)_2$ VIb

wherein L^2 denotes Br, Cl, CN, or I.

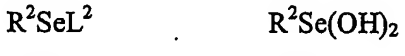
15. Use of a compound of formula I as defined in any of claims 1 to 7, in disulphide bond formation.

16. Use of a compound of formula I as defined in any of claims 1 to 7, for modifying a protein, a peptide or an amino acid comprising at least one thiol group.

17. Use of a compound of formula I as defined in any of claims 8 to 11, for glycosylating a protein, a peptide or an amino acid comprising at least one thiol group.

18. A method of chemically modifying a protein, peptide or amino acid comprising at least one thiol group, the method comprising converting said thiol group into a selenenylsulfide group.

19. A method according to claim 18, wherein the conversion is carried out by reacting the protein, peptide or amino acid comprising at least one thiol group with a compound of formula Xa or Xb:



Xa Xb

wherein:

L^2 denotes a leaving group; and

R^2 denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted benzyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group, or R^2 forms part of or is attached to a solid support.

20. A method according to claim 19, wherein R^2 is phenyl.

21. A method according to claim 19, wherein the compound of formula Xa or Xb is PhSeBr.

22. A method according to any one of claims 18 to 21, further comprising reacting the selenenylsulfide group in the protein, peptide or amino acid with an organic compound containing a thiol group.

23. A method of chemically modifying a protein, peptide or amino acid comprising at least one selenenylsulfide group, the method comprising reacting the protein, peptide or amino acid with an organic compound comprising a thiol group.

24. A method according to claim 22 or claim 23, wherein the organic compound is a carbohydrate compound.

25. A method according to claim 22 or claim 23, wherein the organic compound is a protein, peptide or amino acid.

26. A protein, peptide or amino acid comprising at least one selenenylsulfide group, wherein the selenenylsulfide group is a group of formula:

$$-S\text{-}Se\text{-}R^2,$$

wherein R^2 denotes an optionally substituted alkyl group, an optionally substituted phenyl group, an optionally substituted benzyl group, an optionally substituted pyridyl group or an optionally substituted naphthyl group.

28. A protein, peptide or amino acid comprising at least one selenenylsulfide group which is obtainable by the method of any one of claims 18 to 21.

29. A protein, peptide or amino acid comprising at least one disulfide bond which is obtainable by the method of any one of claims 22 to 25.